

Occupational Health Guideline for Ethyl Ether

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- **Formula:** $C_2H_5OC_2H_5$
- **Synonyms:** Diethyl ether; ethyl oxide; ether; diethyl oxide; sulfuric ether
- **Appearance and odor:** Colorless liquid with a characteristic, sweet ether odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for ethyl ether is 400 parts of ethyl ether per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 1200 milligrams of ethyl ether per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

• Routes of exposure

Ethyl ether can affect the body if it is inhaled, is swallowed, or comes in contact with the eyes or skin.

• Effects of overexposure

1. **Short-term Exposure:** Overexposure to ethyl ether may cause irritation of the eyes, nose, and throat. It may also cause dizziness, drowsiness, unconsciousness, and death.

2. **Long-term Exposure:** Prolonged overexposure may cause loss of appetite, dizziness, drowsiness, headache, exhaustion, excitation, and mental disturbances. It may also increase the severity of the effects of drinking alcoholic beverages. Repeated exposure may be habit forming.

3. **Reporting Signs and Symptoms:** A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to ethyl ether.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to ethyl ether at potentially hazardous levels:

1. **Initial Medical Screening:** Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from ethyl ether exposure.

—**Skin disease:** Ethyl ether can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—**Liver disease:** Although ethyl ether is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

—**Kidney disease:** Although ethyl ether is not known as a kidney toxin in humans, the importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

—**Chronic respiratory disease:** In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of ethyl ether might cause exacerbation of symptoms due to its irritant properties.

2. **Periodic Medical Examination:** Any employee developing the above-listed conditions should be referred for further medical examination.

• Summary of toxicology

Ethyl ether has predominantly narcotic properties leading to anesthesia; it is also an eye and respiratory irritant. Continued inhalation of 2000 ppm in human subjects may produce dizziness. Higher concentrations produce vomiting, pallor, and irregular respiration. Temporary aftereffects are salivation, vomiting, respi-

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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ratory tract irritation, headache, and either depression or excitation. Chronic exposure results in some persons in anorexia, exhaustion, headache, drowsiness, dizziness, excitation, and psychic disturbances. Albuminuria has been reported. Tolerance may be acquired through repeated exposures. Ethyl ether is a mild skin irritant; repeated exposure causes drying and cracking. The vapor is irritating to the eye, and the undiluted liquid causes painful inflammation of a transitory nature. Human subjects found 200 ppm irritating to the nose, but not to the eyes or throat. Permanent aftereffects are rare.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 74.1
2. Boiling point (760 mm Hg): 35 C (95 F)
3. Specific gravity (water = 1): 0.7
4. Vapor density (air = 1 at boiling point of ethyl ether): 2.6
5. Melting point: -123 C (-190 F)
6. Vapor pressure at 20 C (68 F): 442 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 7.5
8. Evaporation rate (butyl acetate = 1): 37.5

• Reactivity

1. Conditions contributing to instability: Heat; sunlight
2. Incompatibilities: Contact with strong oxidizing agents may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving ethyl ether.
4. Special precautions: Ethyl ether will attack some forms of plastics, rubber, and coatings. Ethers, which have been in contact with air or exposed to light for a long time, may contain peroxides. Ethers which contain peroxides may explode when the caps or stoppers of their containers are removed. Ethyl ether, being a non-conductor, may accumulate static electric charges that may result in ignition of its vapors.

• Flammability

1. Flash point: -45 C (-49 F) (closed cup)
2. Autoignition temperature: 160 C (320 F)
3. Flammable limits in air, % by volume: Lower: 1.9; Upper: 36.0
4. Extinguishant: Dry chemical, alcohol foam, carbon dioxide

• Warning properties

1. Odor Threshold: May reports an odor threshold for ethyl ether of 0.33 ppm. Patty notes that the odor is pungent.
2. Eye Irritation Level: Grant states that ethyl ether "causes a transitory smarting sensation if splashed in the eye or if a high vapor concentration contacts the eye, but momentary exposure generally does not cause injury. Prolonged exposure of the cornea to high concentration of ether vapor, such as employed in general

anesthesia, does cause superficial epithelial injury, from which recovery is usually prompt." Patty also reports that in high concentrations ethyl ether causes eye irritation.

3. Other Information: Patty reports that "Nelson et al. reported that human subjects found ethyl ether irritating to the nose, but not to the eyes or throat, at a vapor concentration of 200 ppm."

4. Evaluation of Warning Properties: Through its odor and nasal irritation, ethyl ether can be detected below the permissible exposure limit. For the purposes of this guideline, therefore, it is treated as a material with good warning properties.

MONITORING AND MEASUREMENT PROCEDURES

• General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Method

Sampling and analyses may be performed by collection of ethyl ether vapors using an adsorption tube with subsequent desorption with ethyl acetate and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure ethyl ether may be used. An analytical method for ethyl ether is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 2, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00260-6).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which

includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid ethyl ether.
- Clothing wet with liquid ethyl ether should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of ethyl ether from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the ethyl ether, the person performing the operation should be informed of ethyl ether's hazardous properties.
- Any clothing which becomes wet with liquid ethyl ether should be removed immediately and not reworn until the ethyl ether is removed from the clothing.
- Employees should be provided with and required to use splash-proof safety goggles where liquid ethyl ether may contact the eyes.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to ethyl ether may occur and control methods which may be effective in each case:

Operation	Controls
Use as a solvent in manufacture of smokeless powder	Local exhaust ventilation; general dilution ventilation
Use as a laboratory solvent and chemical extractant	General dilution ventilation; personal protective equipment
Use as a solvent cleaning agent in shoe and textile industries	General dilution ventilation; personal protective equipment
Use as an anesthetic	General dilution ventilation
Liberation from manufacture of alkali or sodium ethylxanthotes by heated processes; from manufacture of warm-process pharmaceuticals; from manufacture of chemicals from cold processes — Grignard reactions and acetic acid recovery	Process enclosure; general dilution ventilation; local exhaust ventilation

Operation

Use as a solvent in manufacture of textiles, cellulose acetate, plastics, and dyes

Liberation during manufacture of cold-process pharmaceuticals

Use as an additive in motor fuels, perfumes, and denatured alcohol

Use in the priming of gasoline engines in cold climates

Liberation during refueling of diesel engines in cold climates

Use as an anesthetic by animal handlers

Controls

Process enclosure; local exhaust ventilation; general dilution ventilation

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General dilution ventilation

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General dilution ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If ethyl ether gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If ethyl ether gets on the skin, promptly wash the contaminated skin with water if the ethyl ether has not already evaporated. If ethyl ether soaks through the clothing, remove the clothing promptly and flush the skin with water. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of ethyl ether, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Swallowing

When ethyl ether has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

- **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

- If ethyl ether is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be collected, dissolved in alcohol of greater molecular weight than butyl alcohol, and atomized in a suitable combustion chamber. Ethyl ether should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

- **Waste disposal method:**

Ethyl ether may be disposed of by dissolving in alcohol of greater molecular weight than butyl alcohol, and by atomizing in a suitable combustion chamber.

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RESPIRATORY PROTECTION FOR ETHYL ETHER

Condition	Minimum Respiratory Protection* Required Above 400 ppm
Vapor Concentration	
1000 ppm or less	Any chemical cartridge respirator with an organic vapor cartridge(s).
4000 ppm or less	Any supplied-air respirator. Any self-contained breathing apparatus.
19,000 ppm or less	A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 19,000 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.